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Small Unmanned Aircraft Systems Detect Turfgrass Drought

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Small Unmanned Aircraft Systems Detect Turfgrass Drought

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Summary. Kansas State University is evaluating the ability of using small unmanned aircraft systems (UAS) to detect drought stress in turfgrass. Their research indicates high resolution remote sensing with small UAS can detect drought stress before it is visible to the human eye. Preliminary measurements of a golf course revealed interesting differences in fairways, tees, and greens between summer and fall seasons. Additional research will be conducted in 2016.

Rationale. New technology may offer the use of small unmanned aircraft systems (UAS) for turfgrass management, but little research has been conducted in turfgrass. Small UAS use remote sensing to measure turfgrass properties and diagnose plant stresses. Small UAS can cover an 18-hole golf course faster than handheld or ground-vehicle platforms.

Objectives. The ability of using remote sensing with small UAS to detect drought stress in turfgrass was evaluated across a gradient of well-watered to severe deficit irrigation plots. The researchers compared the UAS remote sensing measurements with traditional (handheld) techniques. Local golf courses were monitored during the summer and fall to apply the research results.

Study Description. A field study was conducted from June 29 through August 31, 2015, on creeping bentgrass mown at 5/8 inches under a rainout shelter. Six irrigation treatments included 100, 80, 65, 50, 30, and 15% replacement of estimated evapotranspiration (ET). Measurements were taken weekly with a digital camera, modified to include near infrared (NIR), green, and blue bands. The camera was mounted on a hexacopter flown at 50 feet above ground level within three hours of local solar noon. Images were processed for eight vegetation indices (combinations of

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NIR, green, and blue bands) and the three individual bands were evaluated for ability to detect drought stress. Additional measurements included soil moisture at three inches with a FieldScout TDR 300, visual quality, percentage green cover (digital image analysis); and NDVI with a handheld FieldScout 1000.

Results. After 64 days of irrigation treatments, soil moisture was highest in 100 and 80% ET plots and declined with ET treatment (see photo). Soil moisture was statistically similar between 80 and 65% ET, but higher at 100 than at 65% ET. Turfgrass quality was acceptable among 100 through 65% of ET, but quality declined thereafter and was unacceptable at 50 through 15% of ET. Green cover was similar among the 100 through 50% ET treatments, but it declined rapidly at 30 and 15% of ET. Significant bare soil was visible in 15% ET, and less so in 30% ET plots.

Measurements with handheld NDVI detected no differences among the 100 through 50% ET plots. Among the eight vegetation indices and three individual bands, the near infrared (NIR) band (see photo) and Green-Blue vegetation index [(Green – Blue)/(Green + Blue)] were most sensitive. These bands were the only ones that detected differences between 65 and 100% ET, which was similar to the trend in soil moisture described above.

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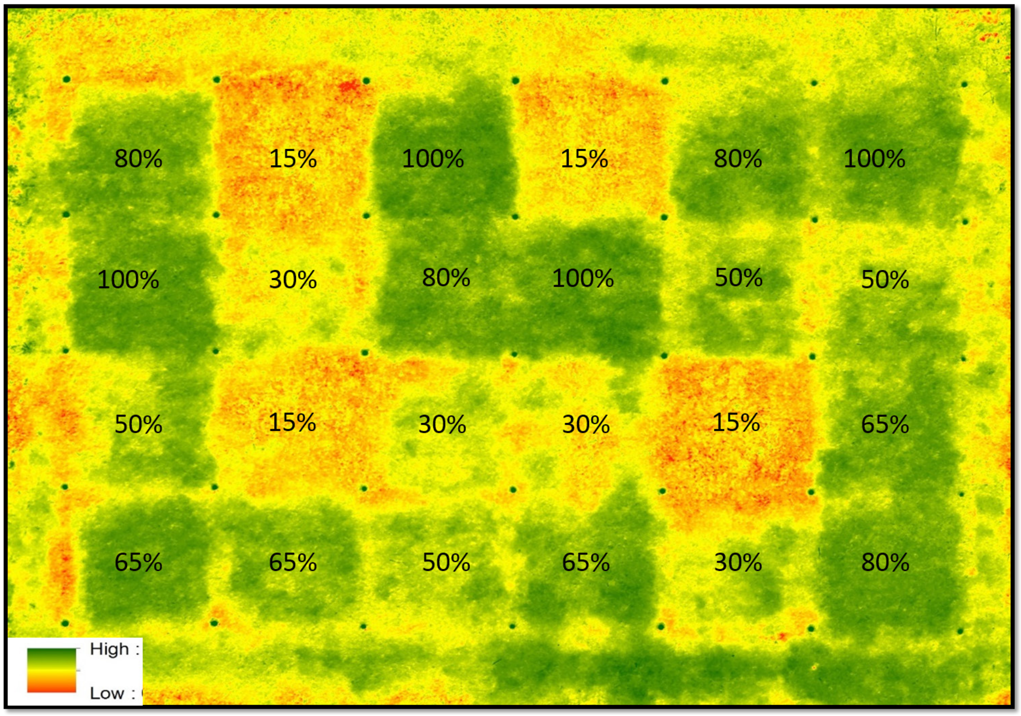

Figure 1. Kansas State University is evaluating the ability of small unmanned aircraft systems (UAS) to detect turfgrass drought stress. This photo is a near infrared (NIR), color-enhanced image of creeping bentgrass irrigation plots maintained as golf course fairway. The irrigation treatments are the percentages of evapotranspiration (ET) replacement. The dark green (High) areas indicate there is more biomass (or healthy turf) in this image created with ArcGIS.

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